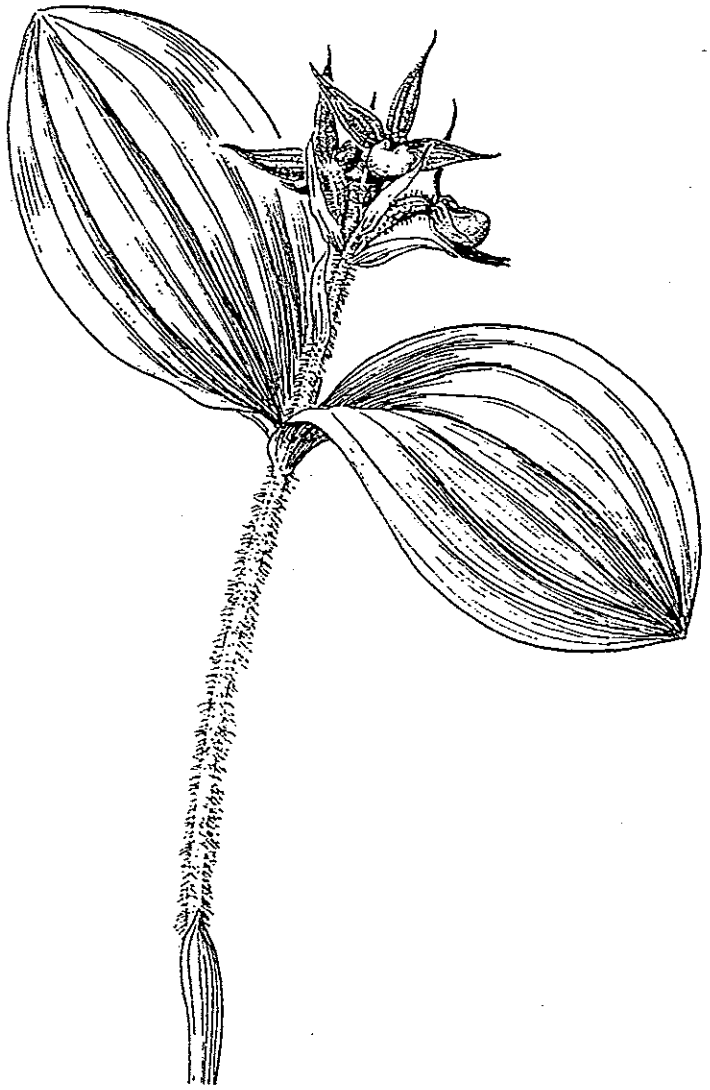

Cypripedium fasciculatum Conservation Assessment

USDA Forest Service, Region 1

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December 1997

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ABSTRACT

This Conservation Assessment provides a review of all current information regarding the distribution, habitat, ecology, and population biology of *Cypripedium fasciculatum* in Region 1 of the USDA Forest Service. This long-lived, rhizomatous, perennial orchid typically occurs in fairly small, scattered populations. Floral morphology, pollinator exclusion experiments, and genetic evidence suggest this species reproduces primarily by outcrossing. The minute seeds are wind-dispersed, and little is known about their germination requirements in the wild. Preliminary population monitoring results reveal populations that do not flucuate dramatically in size, although individuals do enter and leave dormancy. In Montana, *Cypripedium fasciculatum* is most often found in Douglas-fir/ninebark and grand fir/ninebark habitat types, while in Idaho most of the occurrences are in moister western red cedar habitat types. Occurrences in both states experience a Pacific maritime climate and are found under greater than 60% forest canopy closure. Other habitat parameters such as slope, aspect, and soil type are variable. Historically, occurrences in Douglas fir/ninebark and grand fir/ninebark experienced frequent low- to moderate intensity fires with occasional stand replacing fires. In contrast, occurrences in western red cedar habitat types typically experienced stand replacing fires at intervals of over 200 years, and occurrences in drier western red cedar habitat types experienced mixed severity and non-lethal burns at average fire intervals of 30-150 years. Potential threats to *Cypripedium fasciculatum* populations include high intensity wildfire, timber harvest, noxious weed invasion, and grazing. Ongoing monitoring efforts should provide sufficient information for the development of a conservation strategy, including occurrence-specific management recommendations, in the near future.

1. INTRODUCTION

The National Forest Management Act and U.S. Forest Service policy require that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range within a given planning area (FSM 2670.5.22). In addition to those species listed as threatened or endangered under the Endangered Species Act, or that are candidates for such listing, the Forest Service has recognized the need to implement special management direction for other rare species on the lands it administers. Such species may be designated as sensitive by the Regional Forester. The objectives of management for such species are to ensure their continued viability throughout their range on National Forest lands, and to ensure that they do not become threatened or endangered because of Forest Service actions (FSM 2670.22).

Currently, the official status of *Cypripedium fasciculatum* with respect to concerned Federal, State, and private agencies is:

U.S. Fish and Wildlife Service: no status (formerly a Category 2 candidate)

U.S. Forest Service: Sensitive in Regions 1, 2, 4, and 6 (the Regional Forester has identified it as a species for which viability is a concern as evidenced by: a) significant current or predicted downward trends in population numbers or density, and/or b) significant current or predicted downward trends in habitat capability that would reduce its existing distribution (FSM 2670.5.19)).

The Nature Conservancy: G4 (Apparently secure, though it may be quite rare in parts of its range, especially at the periphery)

States:

Montana -	S2 (Imperiled because of rarity, or because of other factors demonstrably making it very vulnerable to extirpation; Heidel 1996)
Idaho -	S3 (Rare or uncommon but not imperiled; Idaho Conservation Data Center 1994)
Washington -	S2/S3 (Washington Natural Heritage Program 1994)
Oregon -	S2 (Oregon Natural Heritage Program 1995)
Utah -	S1 (Critically imperiled because of extreme rarity or because of some factor of its biology making it epecially vulnerable to extirpation; B. Franklin, pers. comm.)
Wyoming -	S2 (Fertig 1996)
Colorado -	S3 (S. Spackman, pers. comm.)
California -	California Native Plant Society List 4 (watch list; Skinner 1994)

The objective of this conservation assessment is to review and compile all known information about the distribution, habitat, ecology, and population biology for *Cypripedium fasciculatum* in Region 1 of the USDA Forest Service. Management recommendations for this species will be forthcoming as part of a future conservation strategy.

2. BIOLOGICAL AND GEOGRAPHICAL INFORMATION

A. Nomenclature and Taxonomy

Scientific name:	*Cypripedium fasciculatum* Kellogg ex Watson
Common name:	Clustered lady's slipper
Family:	Orchidaceae (Orchid Family)
Synonymy:	*Cypripedium pusillum*, *Cypripedium fasciculatum* var. *pusillum*, *Cypripedium knightae*
Lectotype:	White Salmon River, above the falls, Washington Territory, May 1880, *W.N. Suksdorf*, AMES

B. Background Information

Cypripedium fasciculatum was first described from a May, 1880, collection by W. N. Suksdorf near the White Salmon River "above the falls, Washington territory" (Watson 1882). In 1906, *Cypripedium knightae* was described from material collected further east in Wyoming, and was distinguished from the western collections of *Cypripedium fasciculatum* based on plant size and staminodium shape (Nelson 1906). A recent comparison of pubescence length and stem height between the putative eastern and western races showed that while there is geographic variation in these characters, the characters overlap so much that they are not useful for separating the races, and taxonomic recognition is not warranted (Brownell and Catling 1987).

Cypripedium fasciculatum was first collected in Montana in 1912, above Yellow Bay on Flathead Lake by G.P. Norton (Montana Natural Heritage Program 1997). The first collection in Idaho was made by H.J. Rust in 1914, just east of Coeur d'Alene (Idaho Conservation Data Center 1997).

C. Description

Technical: Rhizomatous perennial, with single to loosely- clustered multiple stems; stem 0.5-2 dm tall, lanate-pilose, usually with a single sheathing bract near ground level, a pair of opposite leaves at to well above midlength; leaves sessile, broadly elliptic to oblong-elliptic or elliptic-oval, 2-12 cm long, 4-8 cm broad, rounded-obtuse to slightly acute; flowers 1-5 in a rather tight cluster, each subtended by a greenish bract 1-3 cm long; sepals lanceolate-acuminate, 12-25 mm long, greenish-brown or greenish-purple and usually purple-lined or mottled, the lower pair fused completely or free at the tips only; petals similar to the sepals but usually somewhat broader; lip depressed-ovoid, shorter than the sepals, greenish-yellow with brownish-purple margins and often with a purplish tinge; staminodium 2.5-3 mm long, about equalling the longest lobe of the stigma; ovary densely pilose, unilocular, with parietal placentation; fruit a capsule (adapted from Hitchcock *et al.* 1969).

Non-technical: *Cypripedium fasciculatum* is a perennial with single to multiple stems arising from a creeping underground stem. Each aboveground stem is from 0.5-2 dm tall and is covered with conspicuous hairs. The two leaves are opposite and elliptical-shaped, and the flowering stem arises between them. The 1-5 flowers are arranged in a tight cluster, and each flower is irregularly shaped with three greenish-brown to greenish-purple petals which are

usually purple-lined or mottled. The lowermost petal is pouch-like with brownish-purple margins. The mature fruit is a dry pod about 3 cm long that splits open to disperse minute, dust-like seeds. The distinguishing characteristics are the hairy stems, the two broad elliptical leaves, and the purplish-brownish mottled pouch-like flowers.

Cypripedium fasciculatum (especially in vegetative condition) could be confused with several other plants that occur in the same habitat. All of the *Listera* species (Orchidaceae) in Region 1 have one pair of opposite, ellipse-shaped leaves, but they are generally smaller, scarcely hairy, and lack a pouch-like flower. *Cypripedium montanum* (Orchidaceae) is a fairly common lady's slipper orchid that often co-occurs with *Cypripedium fasciculatum*, but it differs in that it usually has more than two leaves, white flowers, and is generally taller. Finally, *Clintonia uniflora* (Liliaceae) also has a hairy flowering stem with two opposing leaves, but the leaves originate at the base of the plant and the flowers are radially symmetrical with white petals. *Cypripedium fasciculatum* is illustrated in Figure 1.

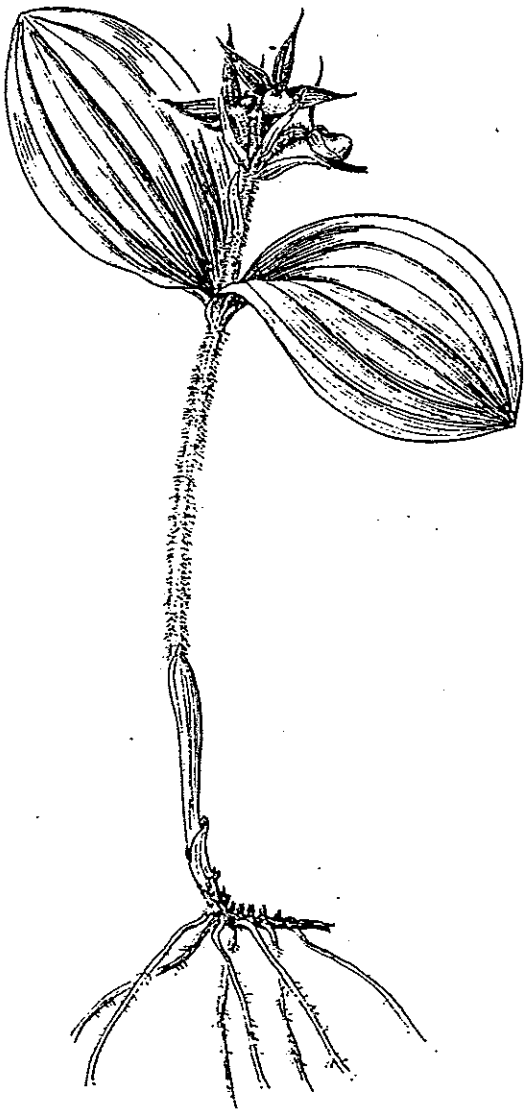


Figure 1. Illustration of *Cypripedium fasciculatum* (Hitchcock *et al.* 1969).

D. Geographical Distribution and Occurrence Information

Cypripedium fasciculatum is currently known from eight states: California (Butte, Del Norte, Humboldt, Nevada, Plumas, San Mateo, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Trinity, and Yuba counties), Colorado (Boulder, Eagle, Grand, Jackson, Larimer, Routt, and Summit counties), Idaho, Montana, Oregon (Douglas, Jackson, and Josephine counties), Utah (Daggett, Salt Lake, and Uintah counties), Washington (Chelan, Columbia, Garfield, Kittitas, Klickitat, Pierce, Skamania, and Yakima counties), and Wyoming (Albany and Carbon counties). Although Hitchcock *et al.* (1969) stated that the species occurs in southern British Columbia, G.B. Straley, who contributed the treatment of Orchidaceae to *Vascular Plants of British Columbia (Part 4)*, was never able to find any material from the province (G. Douglas, pers. comm.). The overall range is shown in Figure 2.

I. Rangewide Distribution

STATE	NUMBER OF OCCURRENCES	
California	numerous	(not tracked by Natural Heritage Division of California Department of Fish and Game)
Colorado	58	
Idaho	98	
Montana	22	
Oregon	184	
Utah	15	
Washington	60	
Wyoming	15	
Total number of occurrences	over 449	

II. Region 1 Distribution

MONTANA		
Lake County	7	(2 historic*)
Mineral County	13	
Sanders County	2	
IDAHO		
Benewah County	2	(1 historic)
Clearwater County	21	
Idaho County	60	(3 historic)
Kootenai County	1	(historic)
Latah County	4	
Shoshone County	10	

The distribution in Region 1 is shown in Figure 3.
*Historic occurrences haven't been relocated since 1960.

E. Life History

Most *Cypripedium* species are outcrossers as reflected by their floral morphology (van der Pijl and Dodson 1966), with the exception of *Cypripedium passerinum*, in which naturally

occurring autogamy (selfing) has been observed (Catling 1983). Evidence from pollinator exclusion experiments for *Cypripedium fasciculatum* supports this generalization; open-pollinated plants bore fertile fruit while emasculated and/or bagged flowers did not produce fruit. However, hand-pollinated self-crosses do yield fertile fruit, indicating that the species is self-compatible (Harrod and Knecht 1994). Isozyme studies in Washington also indicate that *Cypripedium fasciculatum* is an outcrosser. These studies showed little genetic differentiation between the three study populations, suggesting significant amounts of gene flow among the populations, which were within twelve miles of each other (Aagard *et al.*, unpubl.). In spite of what is known about this orchid's breeding system, its pollinator(s) hasn't been identified.

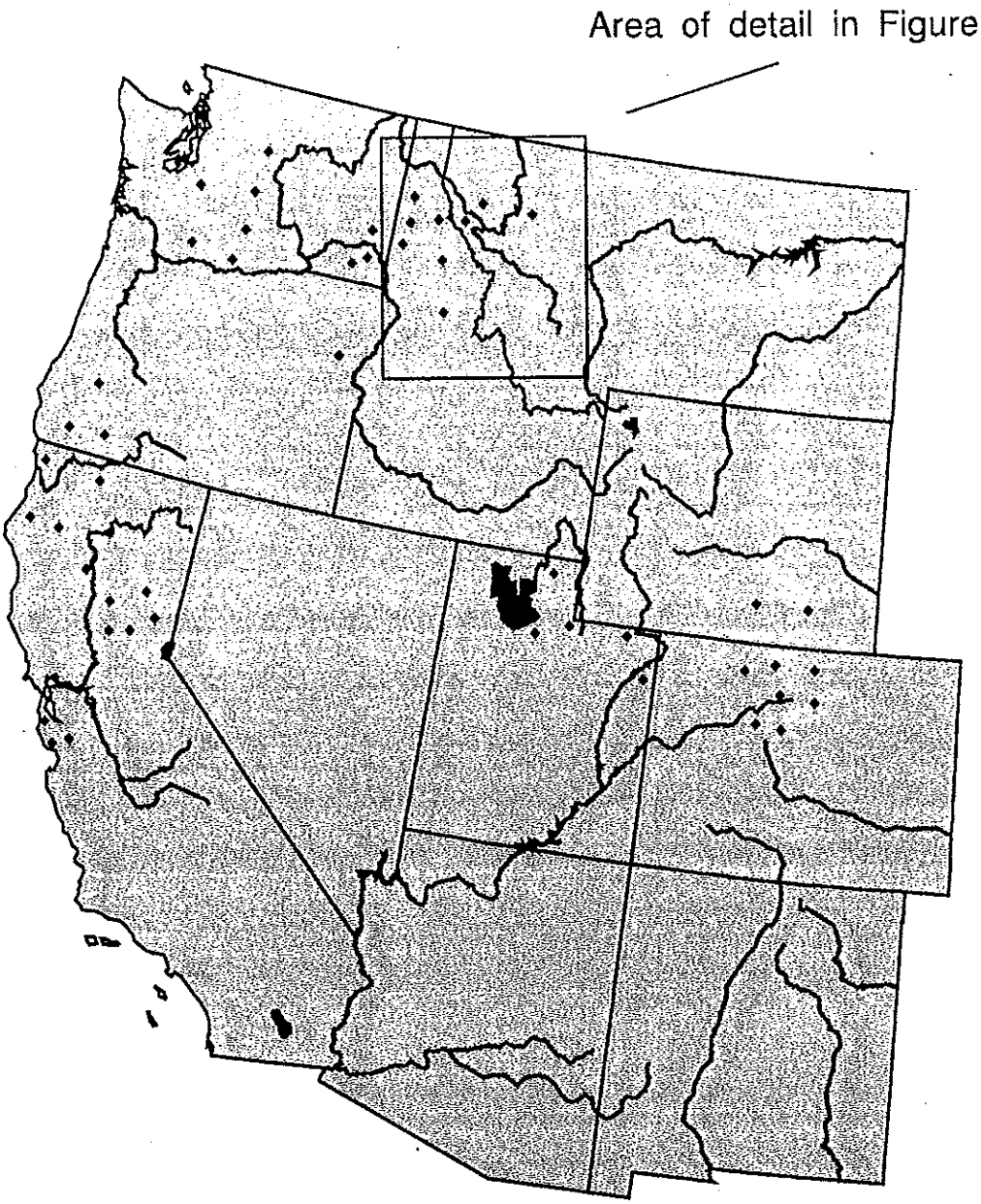
Cypripedium fasciculatum in Idaho and Montana flowers from early May to June. Plants in the Swan Valley in 1991 had 2.55 flowers/flowering stem and 1.28 fruits/flowering stem (M. Mantas, pers. comm.), while 1996 measurements from monitoring plots on the Lolo National Forest showed an average of 0.72 fertile fruits/flowering stem (range 0-4) and 1.52 undeveloped fruits/flowering stem (range 0-5) (pers. obs.). Levels of insect herbivory on the Lolo National Forest in 1996 averaged 5% of leaf area consumed per plant and ranged from 0-90% (pers. obs.).

The seeds of *Cypripedium fasciculatum* are minute and numerous. Studies in Washington found an average of 4,151 seeds per fruit, with an average seed size of 1.41 mm x 0.18 mm (Harrod 1994). Seeds are primarily wind-dispersed, and most seeds recovered during a seed-dispersal study were found within 0.5 m of the fruit source (Harrod and Everett 1993). Elongation of the peduncle after flowering is thought to aid seed dispersal.

Little is known about the germination of *Cypripedium fasciculatum* seeds in the wild. Orchid seeds in the wild must be infected by a suitable mycorrhizal fungus for successful germination to occur (Hadley 1982). Laboratory studies have shown that orchid mycorrhizae can transfer ^{14}C to young host orchids (Alexander and Hadley 1985); this contrasts with the majority of mycorrhizal relationships reported in the scientific literature in which fixed carbon is translocated from the host plant to the fungus (Brundrett 1991). Although there has been no success at getting *Cypripedium fasciculatum* seeds to germinate in the lab in the presence of suitable fungi (R. Harding, pers. comm.), Bill Steele at Eastern Washington University has succeeded in growing this orchid from culture (R. Harrod, pers. comm.) On the Wenatchee National Forest, R. Harrod (pers. comm.) has observed the frequent occurrence of *Cypripedium fasciculatum* populations near game trails, and he is investigating whether the mycorrhiza is a fungus associated with deer or elk feces. In addition, some achlorophyllous orchids have a symbiotic relationship with *Armillaria mellea* (Hadley 1982), one fungus responsible for root rot in conifers in the Northern Region (McDonald *et al.* 1987). Populations of *Cypripedium fasciculatum* on the Lolo National Forest often occur near *Phaeolus* sp. or *Armillaria* sp. root rot pockets, and perhaps there is an association between these fungi and clustered lady's slipper.

F. Population Biology

Monitoring plots established on corporate timberland in the Swan River valley, and on the Clearwater, Idaho Panhandle, Lolo, and Nez Perce National Forests, are starting to provide some preliminary information about *Cypripedium fasciculatum* population dynamics. As noted above there are over 449 occurrences of *Cypripedium fasciculatum* rangewide;



• County in which *Cypripedium fasciculatum* occurs

Figure 2. Rangewide distribution of *Cypripedium fasciculatum*

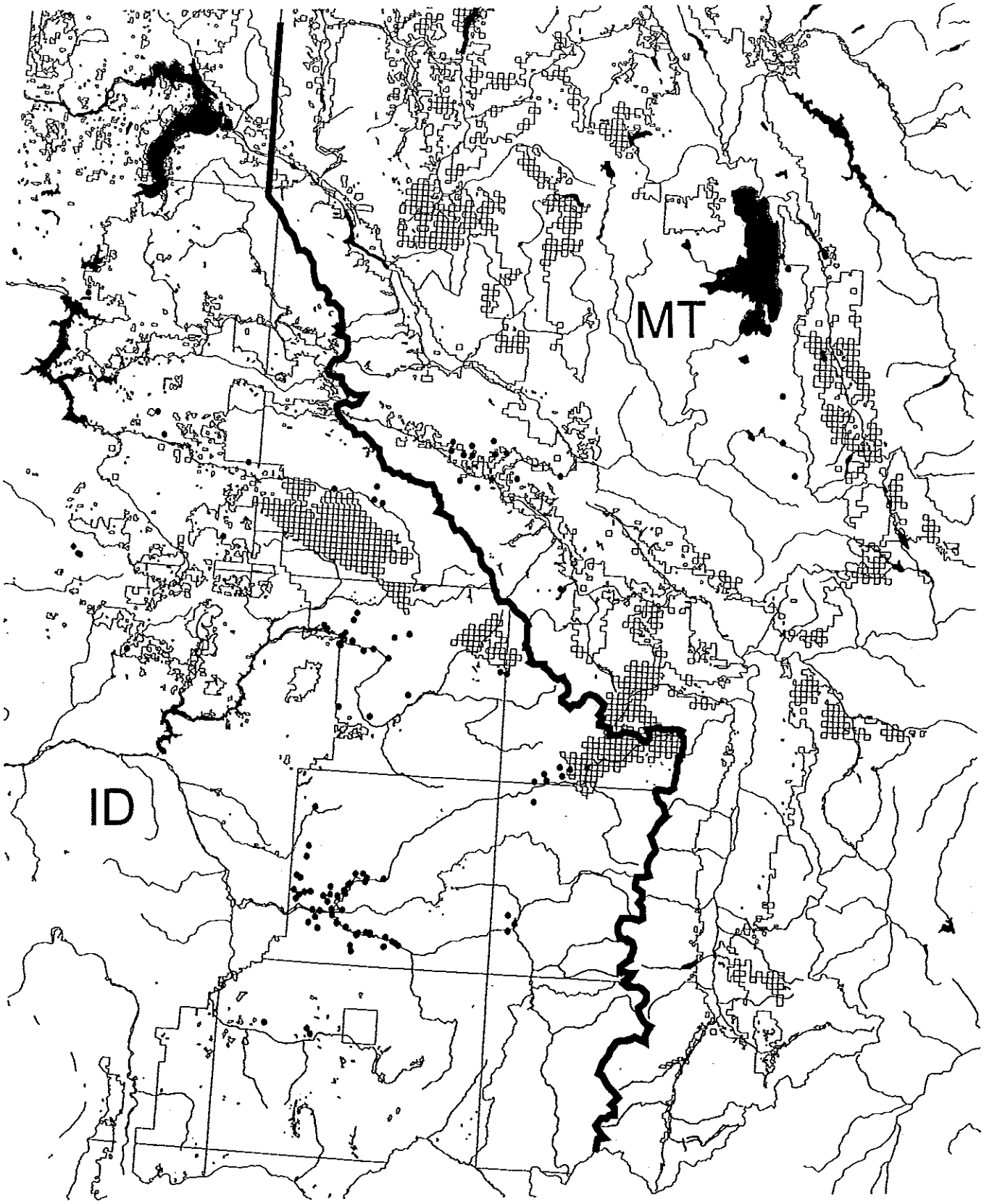


Figure 3. Region 1 distribution of *Cypripedium fasciculatum*

however, many of these are made up of sparsely scattered individuals (Appendix A). Populations in the Swan Valley and on the Lolo National Forest were made up predominantly of reproductive stems during the years plants were observed, with smaller proportions of mature vegetative stems (leaf length≥5cm) and immature stems (leaf length<5cm) (Table 1). Preliminary results after four years of monitoring in the Swan Valley show that flowering plants tend to remain in that life stage from year to year. A percentage of plants may become dormant in any given year, and plants that leave dormancy can return as either vegetative or flowering plants (Lichthardt 1997). Some of the plants with the smallest leaves had up to seven stem scars, indicating that their size was not necessarily indicative of their age (M. Mantas, pers. comm.). New shoots emerged near the previous year's stem, so that plants' locations did not change much from year to year (J. Lichthardt and M. Mantas, pers. comm.). No dramatic fluctuations in population size were observed during four years of monitoring in the Swan Valley (M. Mantas, pers. comm.).

Excavations of rhizomes reveal numerous stem scars, which suggest that this orchid is a long-lived species. Coleman (1989) cites one person who observed a 95 year-old *Cypripedium fasciculatum* individual. Rhizome excavations in other *Cypripedium* species have shown that older sections of the rhizome can die, resulting in 2 identical genets where once only one existed (Summerhayes 1951).

	% Immature stems	% Vegetative stems	% Reproductive stems
Swan Valley	199/550=36.2%	125/550=22.7%	226/550=41.1%
Lolo N.F.	48/344=14.0%	79/344=23.0%	217/344=63.1%

Table 1. Population structure of *Cypripedium fasciculatum* populations in the Swan Valley (Mantas 1991) and on the Lolo National Forest (1996).

G. Habitat

In the Montana portion of its range, *Cypripedium fasciculatum* is most commonly found in moderately warm and dry mid-seral montane forest habitat types. The majority of occurrences are found in the Douglas fir/ninebark habitat type (both ninebark and pinegrass phases (Pfister *et al.* 1977)), grand fir/ninebark habitat type (Cooper *et al.* 1987), or in the transition zone between these types. Two occurrences in the Swan Valley in Montana are in the western red cedar/beadlily habitat type. Commonly associated plant species are shown in Table 2. Densiometer measurements on the Lolo National Forest have shown that the overstory ranges from 60% to 80% canopy closure (pers. obs.). The plants are often found growing under a shrub canopy, usually either ninebark or serviceberry, in mottled, patchy sunlight. *Cypripedium fasciculatum* occurrences are found on all aspects and from 3000-4600 feet in elevation, and most commonly at a mid-slope position on slopes ranging from 30% - 70%; however, occurrences can be found at all slope positions (valley bottom to ridgetop) and on slopes ranging from 2% - 80%.

Most occurrences are in soils of slightly to moderately weathered metasedimentary rocks. Some of the soils are covered with a layer of volcanic ash, and some were under valley glaciers during the Wisconsin ice age. The parent materials are primarily Belt supergroup argillites, siltites, and quartzites. The soil texture varies from moderately fine textured to coarse-textured, with 35%-80% rock fragments (Sasich and Lamotte-Hagen 1989, Montana Natural

Heritage Program 1997). The duff/litter depth is 1-2 inches at some occurrences on the Lolo National Forest (pers. obs.).

The *Cypripedium fasciculatum* sites in Montana experience a modified Pacific maritime climate. The winters are moderately cold, with warm, dry summers. Thirty-five to forty-five inches of precipitation fall each year in this habitat; most of this comes in winter and spring, and over two-thirds falls as snow (Sasich and Lamotte-Hagen 1989).

In contrast to the typical *Cypripedium fasciculatum* occurrences in Montana, over 95% of the occurrences in Idaho are found in moist, well-shaded western red cedar forests in both riparian and upland habitats. The most common habitat types include western red cedar/maidenhair fern, western red cedar/wild ginger, western red cedar/beadlily, western red cedar/ladyfern, and western red cedar/oakfern. Recently, occurrences have been found in dry grand fir and Douglas fir habitat types on the Idaho Panhandle National Forest (M. Mousseaux, pers. comm.) and in a Douglas-fir habitat type on the Nez Perce National Forest (A. Cochrane, pers. comm.). Although most survey efforts have focused on western red cedar habitats, future surveys in drier habitat types could be very productive. Common associated species are shown in Table 3 (Idaho Conservation Data Center 1997). Occurrences are found on all aspects, on slopes ranging from flat to over 90%, in riparian bottoms and toe- and mid-slopes, and in full shade to filtered sunlight. Canopy closure measurements of 55-65% and 70-80% were recorded in plots on the Idaho Panhandle National Forest (M. Mousseaux, pers. comm.) in western red cedar habitat types. In Idaho this plant is found from 1450 feet to 4720 feet, in association with a variety of soils and parent materials, including loam with a gneiss substrate, shallow ash over granitic soils, mica-schist substrate, and alluvial benches. Frequently it is found with moss or a thick duff layer (Idaho Conservation Data Center 1997). Like western Montana, the climate is influenced by Pacific maritime air masses, but with even milder, more moderate winters. Most precipitation falls in winter and spring, and the average annual precipitation is 34.1 inches per year at the Fenn Ranger Station on the Selway River. Summers are warm and dry (Cooper *et al.* 1987).

In summary, *Cypripedium fasciculatum* seems to have evolved into ecotypes that allow the species to occupy a range of ecological niches. This observation is even more striking when rangewide habitats are considered. In Colorado this species is found in lodgepole pine forests from 8000-10,000 feet in elevation (K. Phelps, pers. comm.), while in California it is found on serpentinite seeps and along streambanks (Skinner 1994). Currently, no unique habitat parameter is known that allows biologists to predict future occurrences with more than a very general specificity.

Species	Constancy	Avg. % Cover
Douglas fir (*Pseudotsuga menziesii*)	10	50
ponderosa pine (*Pinus ponderosa*)	6	20
grand fir (*Abies grandis*)	3	10
lodgepole pine (*Pinus contorta*)	2	10
western larch (*Larix occidentalis*)	1	3
ninebark (*Physocarpus malvaceus*)	10	30
serviceberry (*Amelanchier alnifolia*)	10	10
Oregon grape (*Berberis repens*)	10	3
shiny-leaf spiraea (*Spiraea betulifolia*)	9	10
rose (*Rosa* spp.)	9	3
kinnickkinnick (*Arctostaphylos uva-ursi*)	8	10
common snowberry (*Symphoricarpos albus*)	7	10
Rocky Mountain maple (*Acer glabrum*)	7	3
buffaloberry (*Shepherdia canadensis*)	4	3
twinflower (*Linnaea borealis*)	4	3
pipsissewa (*Chimaphila umbellata*)	4	1
ocean spray (*Holodiscus discolor*)	3	3
blue huckleberry (*Vaccinium globulare*)	3	1
Scouler's willow (*Salix scouleriana*)	3	1
orange honeysuckle (*Lonicera ciliosa*)	3	1
pinegrass (*Calamagrostis rubescens*)	9	30
elk sedge (*Carex geyeri*)	4	3
beargrass (*Xerophyllum tenax*)	8	3
raceme pussytoes (*Antennaria racemosa*)	7	3
false Solomon's seal (*Smilacina stellata*)	7	1
white-flowered hawkweed (*Hieracium albiflorum*)	7	1
western rattlesnake-plantain (*Goodyera oblongifolia*)	6	1
narrow-leaved cow-wheat (*Melampyrum lineare*)	4	3
heart-leaved arnica (*Arnica cordifolia*)	4	1
Wilcox's beardstongue (*Penstemon wilcoxii*)	4	1
wartberry fairybells (*Disporum trachycarpum*)	3	1
broadpetal strawberry (*Fragaria virginiana*)	3	1
pinedrops (*Pterospora andromedea*)	3	1
bellflower (*Campanula rotundifolia*)	3	1
dogbane (*Apocynum androsaemifolium*)	3	1
arrowleaf balsamroot (*Balsamorhiza sagittata*)	2	1
yarrow (*Achillea millefolium*)	2	1
white coiled beak lousewort (*Pedicularis contorta*)	2	1
elegant sego lily (*Calochortus elegans*)	2	1
scarlet paintbrush (*Castelleja miniata*)	2	1
Piper's anemone (*Anemone piperi*)	2	1
Alaskan bog orchid (*Habenaria unalascensis*)	2	1
blue-eyed Mary (*Collinsia parviflora*)	2	1
spotted knapweed (*Centaurea maculosa*)	1	1
glacier lily (*Erythronium grandiflorum*)	1	1
mountain lady's slipper (*Cyrpipedium montanum*)	1	1
mountain sweet-cicely (*Osmorhiza chilensis*)	1	1
pathfinder (*Adenocaulon bicolor*)	1	1
twayblade (*Listera* sp.)	1	1

Table 2. Species associated with *Cypripedium fasciculatum* on the Lolo National Forest, based on 9 Ecodata plots. Constancy expressed as out of 10 plots.

IDAHO

Associated trees
western red cedar (*Thuja plicata*)
Douglas fir (*Pseudotsuga menziesii*)
grand fir (*Abies grandis*)
western hemlock (*Tsuga heterophylla*)
white pine (*Pinus monticola*)
western larch (*Larix occidentalis*)
Engelmann spruce (*Picea engelmannii*)
ponderosa pine (*Pinus ponderosa*)

Associated shrubs
Rocky Mountain maple (*Acer glabrum*)
fool's huckleberry (*Menziesia ferruginea*)
ocean spray (*Holodiscus discolor*)
thimbleberry (*Rubus parviflorus*)
serviceberry (*Amelanchier alnifolia*)
cascara (*Rhamnus purshiana*)
twinflower (*Linnaea borealis*)
pacific yew (*Taxus brevifolia*)
mockorange (*Philadelphus lewisii*)
ninebark (*Physocarpus malvaceus*)

Associated forbs
arrowleaf ragwort (*Senecio triangularis*)
baneberry (*Actaea rubra*)
beadlily (*Clintonia uniflora*)
brackenfern (*Pteridium aquilinum*)
bunchberry (*Cornus canadensis*)
common pink wintergreen (*Pyrola asarifolia*)
common swordfern (*Polystichum munitum*)
false Solomon's seal (*Smilacina stellata*)
foamflower (*Tiarella trifoliata*)
Hooker fairybells (*Disporum hookeri*)
ladyfern (*Athyrium filix-femina*)
moss mountain kittentails (*Synthyris missurica*)
northern maidenhair fern (*Adiantum pedatum*)
oakfern (*Gymnocarpium dryopteris*)
pathfinder (*Adenocaulon bicolor*)
Piper's anemone (*Anemone piperi*)
prince's pine (*Chimaphila umbellata*)
western goldthread (*Coptis occidentalis*)
western rattlesnake-plantain (*Goodyera oblongifolia*)
western trillium (*Trillium ovatum*)
wild ginger (*Asarum caudatum*)

Associated graminoids
bearded fescue (*Festuca subulata*)
elk sedge (*Carex geyeri*)
Henderson's sedge (*Carex hendersonii*)
pinegrass (*Calamagrostis rubescens*)

Table 3. Species commonly associated with *Cypripedium fasciculatum* in Idaho.

H. Fire Ecology

The fire ecology of the forest habitats where *Cypripedium fasciculatum* occurs in Region 1 is quite varied. Most Montana occurrences and a few Idaho occurrences are found in the moderately warm and dry Douglas fir/ninebark and grand fir/ninebark types, which historically experienced frequent low to moderate intensity surface fires that occasionally killed groups of overstory trees (Arno *et al.* 1995, Smith and Fischer in prep.). Fire history studies have found fire intervals of 26-50 years in the ponderosa pine phase of the Douglas fir/pinegrass habitat types (Arno *et al.* 1995), 5-50 years in Douglas fir/ninebark habitat types without larch (Arno *et al.* 1985), and 10-50 years in Douglas fir/ninebark habitat types with larch (Arno *et al.* 1985). These fires maintained parklike, all-aged stands of seral ponderosa pine and western larch with some Douglas fir. Presently, however, stands in this habitat type are more densely stocked and have greater canopy closure than they had historically because understory Douglas fir have proliferated in the absence of underburns (Arno *et al.* 1995). The most common understory shrubs are ninebark and serviceberry, both of which are very fire tolerant shrubs that resprout vigorously from rhizomes even after severe fires (Habeck 1992, Hickerson 1986). Prior to 1900, ninebark and serviceberry were probably abundant in seral forest communities that experienced more frequent fire (Arno *et al.* 1985), and they are still fairly abundant today.

In contrast, the forest communities in Idaho and the Swan Valley where *Cypripedium fasciculatum* occurs are generally moister and experienced longer fire intervals. In western red

cedar/beadlily, western red cedar/oakfern, and western red cedar/wild ginger habitat types, the stand replacement fire intervals average 200-250 years, while mixed severity fires and small non-lethal burns occurr at average intervals ranging from 30-150 years. On moister western red cedar/maidenhair fern and western red cedar/ladyfern sites, stand replacement fire intervals average greater than 300 years (Smith and Fischer in prep.). In addition, more frequent spot fires started by lightning would creep around the ground and kill or scar a few trees. Despite nearly a century of fire suppression, the current forest structure in these communities is probably not outside the range of natural variation because of the historically long fire intervals (Arno and Davis 1980).

The distribution of *Cypripedium fasciculatum* in Douglas fir/ninebark habitat types in Region 1 is probably best described as a metapopulation, or a "set of populations ... that are interdependent over ecological time" (Harrison *et al.* 1988) and which are linked by recurrent extinctions and recolonizations. Historically, *Cypripedium fasciculatum* in such habitat types probably "followed" patches of suitable habitat on the landscape as disturbances and successional changes occurred; the landscape was composed of a shifting mosaic of occupied and unoccupied suitable habitats. In order to maintain a viable metapopulation of clustered lady's slipper in the drier Douglas fir habitat types, we need to maintain occupied habitats even as some occupied and unoccupied habitats are treated with silvicultural prescriptions that mimic natural processes. While such treatments will probably cause local declines in subpopulations of clustered lady's slipper, over the long term they will be creating patches of suitable habitat. Metapopulation dynamics may also play a role in western red cedar habitat types, although the temporal scale over which local extinction and recolonization occurred historically would probably have been much greater. Riparian western red cedar harvest in Idaho may have caused fragmentation and isolation of some populations of *Cypripedium fasciculatum* (M. Mousseaux, pers. comm.), thus increasing the importance of metapopulation considerations in viability analyses (Saunders *et al.* 1991).

3. SPECIES RELATIONSHIP TO LAND MANAGEMENT ACTIVITIES

A. Land Ownership in Region 1

USDA Forest Service	111 (4 historic)
Private landowner (MT)	1
Confederated Salish and Kootenai Tribes	6 (1 historic)
Private landowner (ID)	2 (historic)
State of Montana	1
Joint ownership:	
USDA Forest Service and CS&K Tribes	1 (historic)
USDA Forest Service and Plum Creek Timber Company	1

B. National Forest Distribution

Clearwater N.F.	61 (1 historic)
Flathead N.F.	3 (2 joint occurrences)
Idaho Panhandle N.F.	11 (1 historic)
Lolo N.F.	14
Nez Perce N.F.	24 (2 historic)

C. Threats

One potential threat to *Cypripedium fasciculatum* is high-intensity wildfire. On the Wenatchee National Forest in Washington, a wildfire burned through a known *Cypripedium fasciculatum* population in 1994. Where the fire burned hot and totally removed the duff layer, no *Cypripedium fasciculatum* survived. However, the plants did survive low to moderate intensity portions of the burn. Fruit number decreased for plants that survived the burn, but they appeared to have vigorous aboveground growth (D. Knecht, pers. comm.). A population was found on the Powell Ranger District on the Clearwater National Forest two years after a variable intensity wildfire. Presumably the plants existed before the fire and at least part of the population survived the fire. The plants were found where the forest canopy had been killed, and they are now growing under a dense shady overstory of fireweed (A. Pipp, pers. comm.). These observations suggest that *Cypripedium fasciculatum* can survive some low to moderate intensity fires but not higher intensity fires.

As noted earlier, the forest structure, composition, and density of many of the stands where *Cypripedium fasciculatum* occurs in western Montana is outside the range of natural variation (Arno *et al.* 1995, Quigley *et al.* 1996). Fire exclusion has resulted in dense stocking levels of understory Douglas fir, which can serve as ladder fuels. These can increase the risk of stand-replacing wildfire, which may in turn increase the risk of local extirpation of clustered lady's slipper populations.

Another potential threat to *Cypripedium fasciculatum* populations across its range in Region 1 is timber harvest. Populations on the Clearwater National Forest (A. Pipp, pers. comm.), Confederated Salish and Kootenai Tribes' lands (J. Bigcrane, pers. comm.), Flathead National Forest (M. Mantas, pers. comm.), and Lolo National Forest (pers. obs.) are known to occur on lands classified as suitable for timber production. The physical disturbance caused by road building, felling, and skidding trees, as well as the increase in light and temperature due to overstory canopy reduction, can kill individuals and potentially cause downward population trends. Observations of individuals in a clearcut on the Flathead National Forest (M. Mantas, pers. comm.) and in a burn with a fairly open forest canopy on the Clearwater National Forest (A. Pipp, pers. comm.) show that they tend to dry up and turn yellow earlier than plants in less open canopy conditions. In addition, several years ago on the Nez Perce National Forest a blowdown occurred in a population of 58 plants, and only 2 plants could be found in subsequent years (A. Cochrane, pers. comm.). It is possible that intermediate harvest treatments in grand fir and Douglas fir habitat types may represent a mixture of detrimental and beneficial effects; in the short term, individuals may be impacted by timber harvest activities or canopy reduction, but in the long term populations may benefit from the reduced threat of stand replacing fire.

Noxious weeds are another potential threat to this species. On drier sites where *Cypripedium fasciculatum* occurs, spotted knapweed is frequently found along roadsides and occasionally in forest openings; three of eleven occurrences on the Lolo National Forest have spotted knapweed (Montana Natural Heritage Program 1997). These habitats are at moderate risk of weed invasion (Losensky 1987), with risk of spotted knapweed spread increasing after timber harvest activities or after wildfire. Studies have shown that spotted knapweed competes with some rare plant species (Greenlee 1994, Lesica and Shelly 1996). In Idaho, *Hieracium*

pratense is moving up the St. Joe River, invading mesic sites that are potential habitat for *Cypripedium fasciculatum* (M. Mousseaux, pers. comm.)

Grazing is also a potential threat to this species. Several populations in Region 1 occur in grazing allotments, and although high levels of trampling and grazing could pose a threat this plant, no such impacts have been observed (M. Hays, pers. comm.; L. Lake, pers. comm.; pers. obs.) Understory shrubs and coarse woody debris could be preventing cattle use at these sites.

D. Monitoring

Ongoing population monitoring on the Clearwater, Idaho Panhandle, Lolo, and Nez Perce National Forests and in the Swan Valley should provide more information on the life history and population dynamics of clustered lady's slipper. Twelve monitoring plots have has been established in stands on the Lolo National Forest to determine the effects of ecosystem management silvicultural prescriptions (ranging from regeneration harvest [seed tree and shelterwood] to intermediate harvest [commercial thinning and improvement cuts]) on *Cypripedium fasciculatum*. Only one site has been treated so far. The basal area was reduced from 100-120 sq. ft. in 1996 to 40-50 sq. ft. in 1997, and the forest canopy cover was reduced from 80% to 68% in a unit that was skyline yarded during the winter. Preliminary results indicate that the number of individuals in the plot dropped from 26 to 6, and the number of ramets dropped from 47 to 8. Most of the plants that appeared in 1997 were those with large, robust leaves; none of the smaller-leaved plants from 1996 were present. Pre- and post- treatment average reproductive success did not differ; however, there were fewer individuals that bore fertile fruit in 1997 because fewer individuals were present. Monitoring at this site will continue over the next several years to determine whether this decline levels off or continues.

Results of these monitoring efforts should provide managers with enough data so that in the future an informed Conservation Strategy can be developed; it is likely that such a strategy will provide different management recommendations depending on which *Cypripedium fasciculatum* habitat type (Douglas-fir or western red cedar) is being considered.

4. ACKNOWLEDGMENTS

I thank the following individuals for providing me with important information and assistance: Anne Dalton, Joanne Bigcrane, Jeff Collins, Steve Shelly, Juanita Lichthardt, Rick Schneider, Maria Mantas, Mark Mousseaux, Andrea Pipp, Leonard Lake, Alexia Cochrane, Mike Hays, and our cost-share partners, the Confederated Salish and Kootenai Tribes and the Montana Department of Natural Resources and Conservation - Forestry Division. Thanks also to Steve Shelly and Vick Applegate for reviewing drafts of this document. Funding for this project was provided in part by the Native Plant Conservation Initiative, a special project of the National Fish and Wildlife Foundation, created in partnership with the Bureau of Land Management and the U.S.D.A. Forest Service to provide funding for native plant conservation projects.

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Appendix 1. Summary of element occurrence records for *Cypripedium fasciculatum* in Region 1 (1) (Idaho Conservation Data Center and Montana Natural Heritage Program 1997).

EOR No.	Site Name	Elevation (ft.)	Slope (%)	Aspect	Habitat Type (2,3)	No. of Genets	No. of Subpopns.(4)	Area (Acres)
CLEARWATER NATIONAL FOREST								
2	Apgar Campground	1600	flat	--	THPL	14	1	1
7	Lowell *	1600	--	--	--	--	--	--
8	Middle Fork Clrwtr Riv.	1710	--	--	THPL	--	--	--
9	Little Smith Creek	2100-2900	15-vert.	N-E-SW	THPL/ADPE, THPL/ASCA, THPL/POMU, THPL/CLUN	71	---	3
10	Three Devils Creek	1450-1520	50	SE	THPL/CLUN	20	--	.01
11	Star Creek	1920	60-70	SE	THPL/ADPE	1	1	.001
15	Mannering Creek	2800-2900	variable	variable	TSHE/GYDR, THPL/ASCA, THPL/CLUN	860	28	200
16	Aquarius RNA	1750-1900	0-65	N-NE	THPL/ADPE	8	--	--
19	Lochsa RNA	2600	15-35	SW	THPL/ASCA, THPL/ADPE	1	1	.001
20	Mouth of Quartz Creek	2280	35-vert.	W	THPL/CLUN	3	1	.001
22	Pollock Hill NW	4160	35-vert.	E	THPL/GYDR	24	1	.001
23	Isabella Creek	2200-3000	5-85	All	THPL/ADPE, THPL/CLUN, THPL/ASCA, THPL/OPHO	114	13	2
24	Elmer Creek	3200-3500	3-20	SW, SE	THPL	1	--	.001
25	Pollock Creek	4720	35-vert.	SE	THPL	10	--	.001
29	Lottie Creek	3240	35-vert.	SW	THPL/CLUN	8	--	--
32	Papoose Creek Road	3400-3800	60-100	NW, E	THPL/ASCA, THPL/CLUN	34	--	5
34	Pete King Creek	1800	35-vert.	SE	ABGR	7	--	.001
35	Nut Creek	3900	35-vert.	E	--	7	--	--
36	FS Trail 708	2700	41	E	THPL/CLUN	2	--	.001
37	Rye Patch Creek	1525-2400	8-vert.	SE, E	THPL/CLUN	10	3	.1
38	Aquarius RNA-Isabella Landing	1800	15-35	W	THPL/CLUN	12	--	.001
40	Upper Big Smith Creek	3640-3700	35-vert.	NE	THPL/ADPE, THPL/GYDR	7	2	.001
41	Lochsa River - Major Fenn Picnic Area to Bimerick Creek	1680-2200	0-vert.	SW-SE-NE	THPL/ADPE, THPL/CLUN, THPL/ATFF, THPL/ASCA	16	--	.001
45	Deadman Creek	2200	25	W	THPL	8	--	1-3
46	Squaw Creek	3440-3640	38-70	NE-E	THPL/ADPE	81	--	--
47	Canyon Creek	1640-1900	60-65	NNW, SE	THPL/ADPE	9	--	--
48	Pete King Creek	2960	--	SE-SW	THPL/ADPE	9	--	--

EOR No.	Site Name	Elevation (ft.)	Slope (%)	Aspect	Habitat Type (2,3)	No. of Genets	No. of Subpopns.(4)	Area (Acres)
49	Smith Saddle	3280	40-60	E, SE	THPL	33	--	1
50	Outfitter Camp	3050	37	NE	THPL	21	--	.5
51	Steep Creek North	2640	gentle	NE	THPL	6	--	--
52	Steep Creek South	2000	30	E	THPL/ASCA	6	--	.001
53	W. Fork Papoose Creek	3550-4000	65-100	E-NNE	THPL/CLUN, THPL/ADPE, THPL/ASCA	150	3	12
54	Dutchman Creek	3700-3760	--	--	THPL/ASCA	7	2	--
55	Badger Creek	3640-3960	40-80	NE, SE, ESE	THPL/ASCA, THPL/ATFF	77	4	.5
57	Potlatch River	2720	10-15	S	PSME/CLUN (PICO community)	4	--	--
58	Split Creek Bridge	1800	100	NW	THPL	5	--	.001
59	Lodge Creek	4100	moderate	--	THPL/ATFF	--	--	--
60	Chateau Rock Trail	3660	--	--	--	--	--	--
61	NW of Lowell	2880	gentle	SE	THPL/ATFF, THPL/ADPE	1	1	.001
66	Handy Creek	2070	30	NE	THPL/CLUN	28	--	.25
67	Stub Creek East	1700-1750	30	NW	THPL/ADPE	3	--	.5
68	Stub Creek East	2600	35	NE	THPL/ASCA	2	--	.001
69	Pete King Creek	2150-2240	25-40	NE, W	THPL/CLUN, THPL/ADPE	12	2	.001
70	Upper Big Smith Creek	2400	34	SE	THPL/CLUN	11	--	.06
71	Fern Creek	2000-3640	20-70	N-W-S	THPL/CLUN, THPL/ADPE, ABGR/CLUN	35	6	.1
72	June Creek	2800-4000	50-70	N-E	THPL/ADPE, THPL/OPHO, THPL/CLUN	83	3	.25
73	Collins Creek Cabin	2440	100	W	THPL/ADPE	3	--	.001
74	Warm Springs Creek	3440	gentle	--	THPL/ATFF	20	--	.01
76	Lower Badger Creek	3300-3500	70-90	E, ESE	THPL/ASCA, THPL/ADPE	60	6	10
77	Yakus Creek	3580-3600	58	NNW	THPL	6	1	.001
78	Cedar Ck./May Ck.	3640	45	ENE	THPL	29	--	.01
81	Trail Creek	3300-3880	40-56	N-W-SE	THPL/CLUN, THPL/ASCA	30	5	.01
82	Syringa Creek	2360-2400	--	--	THPL	20	2	.1
83	Lower Salmon Creek	2000	15-80	--	THPL/ASCA	22	3	.1
84	Yakus Creek - North of Stray Creek	3350	--	E	THPL	18	--	.1
85	Eldorado Ck./Snow Ck.	3240	gentle	W	THPL	3	--	.001
86	Lower Crooked Fork Creek	3640-3900	21-80	W	THPL/CLUN	116	3	.01
91	Parachute Creek	4200	60-70	E	THPL/CLUN	4	--	--

EOR No.	Site Name	Elevation (ft.)	Slope (%)	Aspect	Habitat Type (2,3)	No. of Genets	No. of Subpopns.(4)	Area (Acres)
95	Owl Creek West	3070	60	WNW	THPL/ASCA	3	--	.001
IDAHO PANHANDLE NATIONAL FORESTS								
13	Eagle Creek	3000	70	NW	THPL	35	--	.01
14	Rochat Ridge *	5500	--	--	--	--	--	--
30	Hobo Cedar Grove Botanical Area	4300	3-8	NE	THPL/ASCA	1	1	.001
56	Quartz Creek	3030-3320	60-90	N, NW	THPL/CLUN	25	--	20
87	Eagle Creek	3400-3600	0-55	--	THPL/GYDR, ABGR/CLUN	17	4	--
88	St. Joe River/Bacon Ck.	4040	0-70	--	ABGR	--	--	--
92	Skookum Creek	2750-2900	5-10	E, SW	THPL/OPHO	10	2	.01
93	Black Prince Creek	2900	45	SE	THPL/ASCA	12	3	3
	Bond Creek**	2350-2800	80	W	THPL/CLUN, ABGR/CLUN	79	3	2
	Bird Creek**	3100-3600	45-65	SE, W	THPL/CLUN, TSHE/GYDR	16	4	--
	Malin Creek**	2840	45	W	THPL/OPHO	20	1	--
IDAHO PRIVATE								
12	Fernan Hill *	2700	--	--	--	--	--	--
65	Burnt Creek	1950-2000	30-60	E	THPL/ADPE	3	--	4
75	Ahrs Gulch	2800	--	S	PSME/PHMA	2	--	.001
	Lake Coeur d'Alene**	2200	25	SE	PSME/PHMA	115 ramets	1	.25
NEZ PERCE NATIONAL FOREST								
1	O'Hara Creek Road	2100	35-55	NE	THPL/ADPE	3	1	--
3	Cache Creek	1600-1700	8-15	W	THPL/CLUN	4	1	.001
4	Falls Creek *	1800	--	--	--	--	--	--
5	Tony Creek	2650	60	E	THPL/ADPE	--	--	--
6	Fenn Ranger Station *	1600	--	--	--	--	--	--
17	Twentymile Bar	1650	3-8	S	THPL/CLUN	12		.001
18	O'Hara Creek	2160-2350	30-vert.	N, E	THPL/ADPE, THPL/CLUN	17	--	.001
21	Rackliff Campground	1650	8-30	S	THPL/ASCA	44	2	.001
26	Mouth of Slide Creek	1800	--	--	THPL	10	--	--
27	Moose Ck. Ranger Stn.	2470	15-35	SE	ABGR/CLUN	1	--	.001
28	Big Rock Tr.-Shissler Peak South	4400	35-vert.	W	THPL	4	--	.001
31	Fall Creek	4160-4400	80-120	S-W	ABGR	216	14	9
33	Fall Creek	4100	60	SE	ABGR/CLUN	--	--	--

EOR No.	Site Name	Elevation (ft.)	Slope (%)	Aspect	Habitat Type (2,3)	No. of Genets	No. of Subpopns.(4)	Area (Acres)
39	Selway River Mile 113	1650-1700	35-vert.	NE	THPL/ASCA	2	--	.001
42	Lodge Creek	3620	--	S	THPL/ATFF	2	--	--
43	Swiftwater Creek	3840	65	SE	THPL/ASCA	1	--	--
44	Lodge Point NE	3200	15-35	N	THPL/ADPE	10	--	.001
62	Slide Creek	1850-1900	60-70	E	THPL/ADPE	4	--	.01
63	Sob Creek	1680-1740	45-60	N-NNE	THPL/ADPE	17	2	.001
64	Swiftwater Road	1640-2200	50-80	N, NE	THPL/ADPE, THPL/CLUN, THPL/ASCA	80-90	--	160
79	Horse Point NE	2000	--	--	THPL/ADPE	15	--	.1
89	East of Wash Creek	3760-3880	27	N	THPL/ATFF	150	--	.25
90	Fern Creek	2100	80	N	THPL/ADPE	2	--	--
94	Granite Creek	4040-4300	30-50	W-SW	PSME	65	--	2
FLATHEAD NATIONAL FOREST/MONTANA PRIVATE								
3	Bear Trap Mountain *	4500	--	--	--	--	--	--
4	Cedar Creek	4100	22	SE	THPL/CLUN	200 ramets	1	1
5	Piper Creek	4000	15-18	E	THPL/CLUN	30	2	1
18	Bohannon Ck	2995	2	W	--	30 ramets	1	--
LOLO NATIONAL FOREST/STATE of MONTANA								
6	Two Mile Creek	3640	50	SW	ABGR/CLUN to PSME/PHMA	377	3	1
7	Tamarack Creek	3400	30-70	SW-E	ABGR/CLUN to PSME/PHMA	321 ramets	21	100
9	Clark Fork/Falls Creek	3100	30-70	N-NW	PSME/PHMA	100	2	1
10	South Fork Little Joe	3400	28-75	All	ABGR/CLUN to PSME/PHMA	1900 ramets	49	100
11	Mullan Gulch	3300	80	SSW	PSME/PHMA	160	14	1
12	Cabin City Campground	3320	24	SSW	PSME/PHMA	47 ramets	4	1
13	Cabin City	3820	78	W	PSME/PHMA	21 ramets	2	1
14	Quartz Creek	3680	37-55	W-NE	PSME/PHMA	68 ramets	2	1
15	Mullan Creek	4600	70-80	W	PSME/PHMA	43	3	1
16	St. Regis	3000	36-47	E-NE	PSME/PHMA	265 ramets	5	2
17	Boyd Mountain	4160	--	NE	PSME/PHMA	21	1	--
19	Butler Gulch	4300-4400	45-50	W	ABGR/LIBO to PSME/PHMA	130	2	5
20	Fourmile Creek	3300-4100	2-70	S, NW	ABGR/LIBO to PSME/PHMA	1100	3	180
21	Lower Tamarack Ck.	3000-3350	10-40	SE-SW	PSME/PHMA	107	3	5
	Elk Point**	4600	35	SSW	PSME/PHMA	33	1	.01

(See notes on next page)

1 No tribal EOR's are reported here; for more information contact the Confederated Salish and Kootenai Tribes, Division of Lands, Pablo, MT.
2 Abbreviations constructed using the first two letters of the genus name followed by the first two letters of the species.
3 Follows Cooper *et al.* (1987) and Pfister *et al.* (1977).
4 Subpopulations linked to the same EOR.

* Historical location that has not been relocated
** No EO # as of publication date